# Automated Sound Speed Classification for Optimized Search Tactics

Don Delbalzo
Naval Research Laboratory, Code 7183
Stennis Space Center, MS 39529
Phone: (228) 688-5458 Fax: (228) 688-5763 Email: delbalzo@nrlssc.navy.mil
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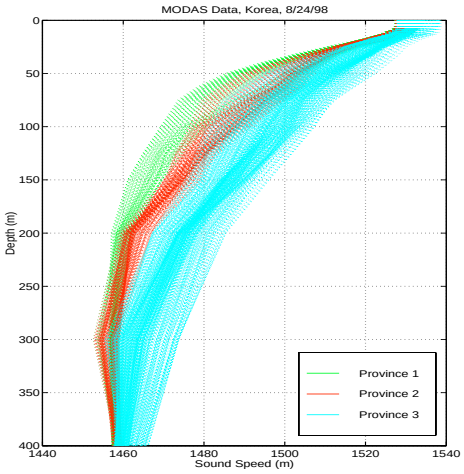
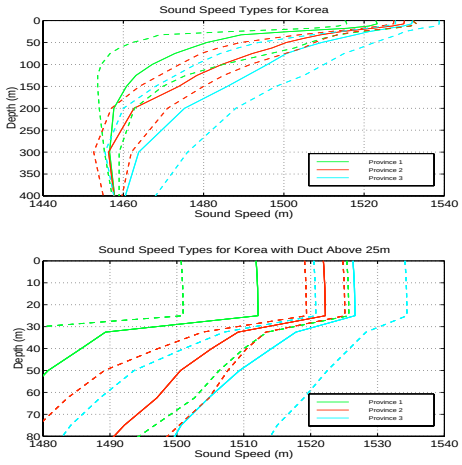
## LONG-TERM GOAL

My long-term goal is to provide an enhanced acoustic performance prediction capability for Navy sensors and operations. A second goal is to fully address the local sound speed profile (SSP) field by developing efficient methods to incorporate Modular Ocean Data Assimilation (MODAS) information.

My working hypothesis is as follows. For a given local area, the current acoustic environment defines areas where target detection is probable and areas where it is not. Rather than having a valuable Navy platform conduct a potentially inefficient, equally-spaced, rectangular search pattern for detecting targets, the local environment and existing acoustic models can be used to derive an expedient and optimized pattern that is specific to the area. This capability is particularly relevant in shallow water areas where oceanographic, and therefore acoustic, characteristics can exhibit extreme temporal and spatial variability.




***MODAS sound speed profiles used to create provinced sound speed field***




***Provinced sound speed profiles without and with a duct***

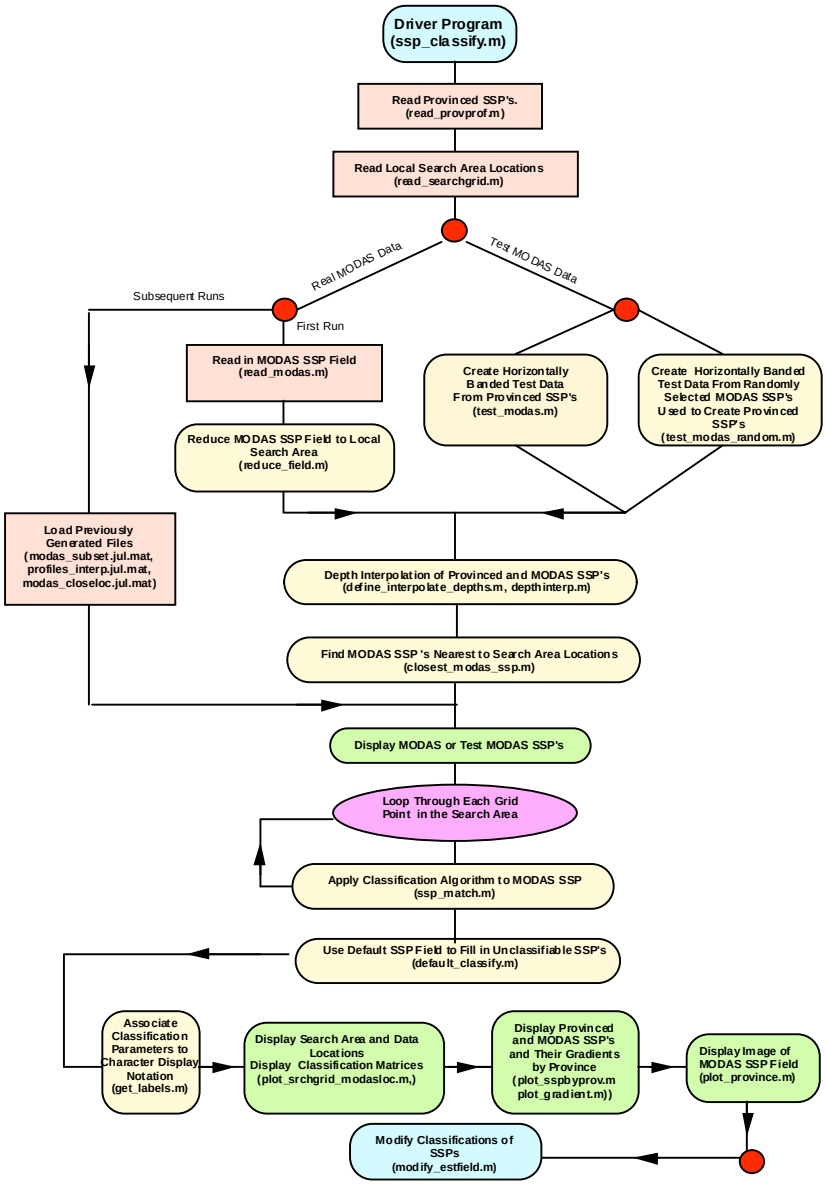
## OBJECTIVES

The objective of my FY98 effort is to develop a software tool that employs easily obtained environmental parameters to optimize the Navy's acoustic search capabilities. The software program

incorporates a feature analysis algorithm for classifying individual SSPs and another algorithm for provincing the SSP field based on the individual classifications.

## APPROACH

During 1998, I focused on algorithm development and validation. Specifically, the software tool developed uses both historical SSP information and actual MODAS profiles extracted from the area of interest. By using real, and easily obtained, environmental data to supplement and/or replace precalculated model SSP predictions, the search optimization tool will be especially useful for performance assessment and mission planning in regions characterized by anomalous environmental conditions.




***Flow chart of the sound speed classification software. Red circles denote user-input choices.***

The feature analysis algorithm examines gradients for classifying individual profiles but can also incorporate ducts if present in the area. Importantly, the SSP categorization approach is to define key (canonical) profile types using real data.

## WORK COMPLETED

This year's major accomplishments include: (1) completion and validation of the classification and categorization algorithms; and (2) initial field testing of the software during the SHAREM 126 exercise, held in September 1998, in the Sea of Japan.

## RESULTS

Laboratory testing and field application of the software program during SHAREM 126 was very successful. A library of 18 SSPs was developed for feature recognition. Three main water mass categories were identified in the SHAREM area: "hot", "cold" and "transitional". For each of these, mean, maximum, and minimum SSPs were derived, resulting in 9 SSPs. Although a strong surface duct was not expected during the exercise, nine additional SSPs were created by superimposing a 25-m mixed layer to the top of each SSP, thus completing the SSP library. The resulting categorization of the SHAREM SSP field adequately mirrored the three major water masses.

## IMPACT / APPLICATIONS

Development of a tactical search optimization tool that maximizes use of MODAS information will provide valuable guidance in performance assessment and mission planning for antisubmarine and mine warfare activities.

## TRANSITIONS

Although transition of the present effort is pending, I envision the product to be integrated with other acoustic search track algorithms to create a larger, seamless package.

## RELATED PROJECTS

The present effort is related to other Tactical Decision Aids (TDAs) such as the Sonar In-Situ Mode Assessment System (SIMAS), Tactical Control Program (TCP), and the Integrated Carrier ASW Prediction System (ICAPS).